27583
S/102/61/000/001/001/005
D274/D303

16.8000 (1031, 1013, 1068)

AUTHOR: Ivakhnenko, O.G. (Kyyiv)

TITLE: The invariance theory as applied to differential control-systems

PERIODICAL: Avtomatyka, no. 1, 1961, 3-24

TEXT: Methods of modern invariance-theory are applied to four types of differential control-systems, the invariance conditions being used for eliminating the effect of external noises (disturbances) and of changes in nonlinearity and in system parameters. A system is called differential (in the narrow sense of the term) if rigidity in adjustment is obtained by varying the difference between parameters other than the reference voltage Ψ. Denoting by Φ the controlled variable, by M the controller, and by L the principal noise, the following four basic types of differential control-systems are obtained:

Card 1/7

The invariance theory...

$$\Sigma = -m(p)\Phi + l(p)L + \Psi, \qquad (I)$$
$$\Sigma = -n(p)M + l(p)L + \Psi, \qquad (II)$$
$$\Sigma = -n(p)M + m(p)\Phi + \Psi. \qquad (III)$$
$$\Sigma = -n(p)\Phi + k(p)\Psi = -m(p)\Phi + k'(p)\Psi. \qquad (IV)$$

The last system applies to servo-mechanisms. The equivalent transformations lead to control laws of other systems whose properties are well known. The equivalence conditions thereby determined are used for synthesizing the system and the choice of its parameters. On the differential-stabilization system with noise-constraints and external feedback, the control law is given by Eq. (I). A diagram of the system is shown. An analysis of the system's equations shows that in the general case its linearized steady-state characteristic may not pass through the origin of coordinates. Two types of equivalence conditions are derived. Type a):

$$l'(p) = \frac{m(p)\beta(p) + l(p)}{1 + Y_1(p)Y_2(p)m(p)}, \qquad (1)$$

Card 2/7

The invariance theory...

$$\Psi' = \frac{\Psi}{1 + Y_1(p)Y_2(p)m(p)} \qquad (2)$$

These are the conditions for equivalence to a system controlled by noise-constraints only. Type b)

$$m'(p) = \frac{m(p) + \frac{1(p)}{\beta(p)}}{1 - \frac{1(p)}{\beta(p)} Y_1(p)\, Y_2(p)} \qquad (3)$$

$$\Psi' = \frac{\Psi}{1 - \frac{1(p)}{\beta(p)} Y_1(p)\, Y_2(p)} \qquad (4)$$

These are the conditions for equivalence to a system controlled by deviations of the controlled variable. Further, the characteristic equation and the invariance condition are derived. Absolute invariance of Φ with respect to L is expressed by

Card 3/7

The invariance theory...

$$\beta(p) - 1(p)\, Y_1(p)\, Y_2(p) = 0 \qquad (2b)$$

On the differential stabilization system with noise constraints and internal feedback, the control law is given by Eq. (II). A block-diagram of the system is shown, as well as two particular circuit-diagrams, exemplifying it. The equivalence conditions, the characteristic equation, and the invariance condition are derived. The equivalence conditions show that the system is operational only if the controlled processes (elements) are static and stable. On a differential stabilization system without noise constraints, a block diagram and examples of circuit diagrams are shown. From the equivalence condition it follows that this system is equivalent to a differential system with noise constraints and external feedback. The condition of absolute invariance is $1 - n(p)\, Y_1(p) = 0$ (Y_1 denotes the amplifier). On differential servo-system with noise constraints, the equivalence conditions show that the system is equivalent to a system controlled by deviations and by noise derivatives. The characteristic equation and the invariance conditions are derived. The

Card 4/7

The invariance theory...

conclusion is reached that an internal-feedback system is equivalent to a deviation-controlled system. The rigidity of the latter system might be lower than that of the former. The practical application of the equivalence conditions depends on whether enough operators (for system synthesis) can be found to satisfy these conditions. The equivalence conditions are particularly useful in the synthesis and adjustment of systems without noise constraints; thereby a system of great rigidity (s = 100 to 1000) can be obtained, described by

$$- n(p) + (1 - k)\, Y_2(p)m(p) = 0, \qquad (25)$$

(where k = 0 to 1). Differential systems with noise constraints (and external- or internal feedback) have the advantage that great rigidity can be readily obtained for large values of steady-state stability factor, (which is not the case with simpler systems). In such systems, the steady-state error can be fully compensated; the steady-state factor γ can have even negative values. Further, the conclusion is reached that negative γ can be also obtained in systems with internal feedback (without noise-constraints); in this

The invariance theory...

case however, the stability has to be maintained by derivative feedback. In differential systems with noise-constraints, the dynamical error, too, can be compensated and overcompensated (without affecting stability). Systems without noise-constraints behave differently. An investigation of concrete systems showed that overcompensation of the dynamical error is possible, but only if stabilization methods are used. The smaller the rigidity required, the easier stability can be ensured. An example is given which illustrates the relation between invariance, equivalence and rigidity. Differential systems with noise constraints and internal feedback have the disadvantage that the controlled process is beyond their influence; therefore, the non-linearities and changes in process-parameters are not affected by the feedback. On the other hand, if the process (or element) is sufficiently stable, such differential systems are advantageous, as their stability is high (even in comparison to deviation control-systems). The larger the time constant of the process and the smaller the time constant of the amplifier, the greater the advantage (in stability) of differential systems with

Card 6/7

noise constraints. On compensation of non-linearities in the various units of differential systems, small changes in non-linearity and parameters are considered. An example is given which shows that small changes (in time) of non-linearities and parameters of a unit do not give rise to errors if the transfer function of the unit is not involved in the pertinent invariance-conditions. The changes are compensated by fast differential regulators. As a typical example of control by a differential system, an induction motor is considered. The motor, with current- and voltage feedback, constitutes a differential feedback system. A diagram of the system is given which illustrates the use of invariance theory in arbitrarily changing the dead zone of an induction motor. There are 6 figures, 2 tables and 10 references: 9 Soviet-bloc and 1 non-Soviet-bloc (which is a translation into Russian).

SUBMITTED: October 10, 1960

13,2000

30559
S/509/61/002/000/005/008
D298/D302

AUTHOR: Ivakhnenko, A.G. (USSR)

TITLE: On applying the combined-control theory to cybernetic adaptive systems

SOURCE: IFAC, 1st Congress, Moscow 1960. Teoriya diskretnykh, optimal'nykh i samonastraivayushchikhsya sistem. Trudy, v. 2, 1961, 709 - 725

TEXT: The invariance theory is further developed in the report. It is shown that the theory is not only applicable to ordinary systems with constant characteristics, but also to cybernetic (adaptive) systems. The invariance conditions are defined as the conditions imposed on the coefficients of the system equations and on the principal disturbances, under which the system error vanishes identically $\Delta = \varphi = 0$. A table lists four different forms of invariance conditions, each with its own range of application. The first type of conditions is called non-absolute invariance, the second -- absolute invariance. Absolute-invariance conditions can be

Card 1/4

On applying the combined-control ...

mainly achieved in combined systems, i.e. systems incorporating control by both deviation and disturbance. Two methods of system adjustment are mentioned, involving selection of the coefficients of the right-hand side of the dynamical equations (first method), and those of the left-hand side (second method). Combined systems are advantageous under both steady-state- and dynamic conditions. Choice of configuration is examined: Depending on whether all the noises and disturbances can be measured or not, an open-loop or a closed-loop (feedback) configuration has to be used. If only part of the noises and disturbances can be measured, a combined configuration is used. The theory of combined stabilization systems, developed for ordinary non-adaptive systems, can be used, after slight modifications, for combined adaptive systems. This is a basic assumption of the present work; it is illustrated by means of extremal systems. It was established that adaptive systems under disturbances have stability in operation for very large mean-gain factors, much larger than those of ordinary non-adaptive systems. A table shows, for comparison, the control laws and steady-state characteristics for a stabilization system and an extremal system

respectively. The invariance conditions can be applied to all types of extremal controllers, including nonlinear- and variable-parameter systems. The above selection rules for the configuration apply to both ordinary- and adaptive systems. If adaptive controllers are combined with an ordinary system so that each controller adjusts the characteristic of the preceding one, then the control problem is solved by iteration (the method of successive approximations). Below, five methods for increasing noise-stability are listed (and their relative accuracy): cross-correlation -- 1.0; autocorrelation -- 0.8 - 0.9; integration -- 1.0; cross-correlation with simultaneous signal-filtration -- 1.1 - 1.2; complex signals -- over 1.5. This order of accuracy applies to both open-loop and closed-loop systems. The figures given were experimentally verified on a model of type MH-7 (MN-7). As the complex-signal method is not sufficiently developed as yet, and the integration method is rather cumbersome, the cross-correlation method is most convenient in practice. The basic equipment, required by this method, is in serial production (controller BTИ (VTI) of type ЭР (ER)). Two block-diagrams of systems with high noise-stability are shown. There are three appen-

On applying the combined-control ...

dices to the report: 1) Method of optimum adjustment of combined systems, "by stages". 2) Example of steady-state method; 3) Selection of coefficients of combined loops by means of invariance conditions. A short discussion followed. Taking part was Shnorin (USSR) There are 5 figures, 3 tables and 14 references: 10 Soviet-bloc and 4 non-Soviet-bloc. The references to the English-language publications read as follows: N. Minorskiy, Directional stability of automatically controlled bodies. Journ. American Society of Naval Architects, v. 34, 1922; I.R. Moore, Combination open-cycle closed control systems, Proc. IRE, v. 39, no. 11, 1951; R.F. Drenick, H.A. Shachbender, Adaptive servomechanisms, Trans. AIEE, v. 76, part II, 1957; J.A. Aseltine, A.R. Mancini, C.W. Sarture, A survey of adaptive control systems, IRE, Trans. automatic control, PGAC-6, Des., 1958.

Card 4/4

30975
S/102/61/000/003/001/007
D251/D302

16,8000 (1103, 1329, 1031)

AUTHOR: O.H. Ivakhnenko, (Kyyiv)

TITLE: Comparison of cybernetic sampled-data systems, differing in extremum search strategy

PERIODICAL: Avtomatyka, no. 3, 1961, 3 - 29

TEXT: Using the methods outlined by Chang and Van Nice the author compares the potential possibilities of 4 types of sampled-data systems, each of which has 4 variations of the law of change of the manipulated variable. The 4 systems are: 1) A system with two trial steps (derivative sensing system), 2) a system with rectangular modulating influence (alternating basing or continuous test signal system), 3) a system with many trial steps, and 4) a step system without trial steps. The basic equations of the systems are established, using the methods of Chang, Van Nice and O.M. Krizhanivs'kyy and V.Ya. Soltyk (Ref. 6: Avtomatyka, no. 4, 1960), and making various approximations. In particular, the extremum characteristics are approximated by straight lines, and a new method of minimum error

Card 1/3

Comparison of cybernetic ...

estimation is used. By the minimum sampling interval, an estimate of the speed of the systems is obtained, and the optimum steps which correspond to the minimum mean square error being equal for all systems. It was found that system 2 and 4 have the highest speed. The effect of noise was investigated. It was found that noise decreased the optimum speed in all systems, but that the effect of noise decreases as the number of integrations in the signal of a given system increases. The highest potential noise resistance was found to occur in a continuous test signal system with double integration of the signal. Special methods of increasing noise resistance are dealt with in the author's book (Ref. 9: Tekhnicheskaya kibernetika(Technical Cybernetics) Gostekhizdat USSR, 1959). The methods of Chang and Van Nice are used to estimate the optimum sequence of coefficients w_i ($i = 1,...n$) of the links from the last and preceding extremum measure differences. Since the values of w_i depend to a great extent on the parameters of drift, and for the most important form of drift approximation - rectangular non-periodic drift - they equal zero, it is concluded that the method of control by preceding differences should not be used. In the case of system 4, however, this conclusion does not apply. In this case, the

4

27137
S/102/61/000/004/003/004
D274/D302

16.8000 (1031, 1121, 1132)

AUTHOR: Ivakhnenko, A. O.G.

TITLE: A simplified method of solving nonlinear differential equations and equations with time-varying parameters

PERIODICAL: Avtomatyka, no. 4, 1961, 69-73

TEXT: A method is described which can be used for integrating non-linear equations and equations with time-varying parameters which contain only one time-derivative of any order (i.e. in operator notation, equations which contain the operator $p = d/dt$ only once). The method involves the use of a special, variable, time scale. The method is explained by the following examples. Example 1: It is required to solve the non-linear equation

$$L(i)pi + ri = U_o,$$

where

$$p = \frac{d}{dt}, \quad L(i) = \frac{\Delta\Psi}{\Delta i} \quad \text{and} \quad U_o = [U_o].$$

Card 1/4

A simplified method...

(i denotes the current). First, this equation is integrated by the method of successive approximations, for U_o = 7.65 volt and r = 8.5 ohm. The result of this integration is shown in a figure. Further, the new method is used. The variable time-scale $\omega_o(t)$ is introduced; the new time is denoted by T. The initial equation in the new time is

$$L(i)\omega_o' Di + ri = U_o$$

The time scale $\omega_o(t)$ is chosen so that $L(i)\omega_o' = L' = \text{const}$; L' can be chosen arbitrarily. Taking $L' = r = 8.5$ henry, one obtains the solution

$$i = \frac{U_o}{r}\left(1 - e^{-\frac{T}{\left(\frac{L'}{r}\right)}}\right)$$

The new method is approximate, as the integral expression for T was replaced by a sum. The results obtained by the new method are in good agreement with those obtained by successive approximations. A more detailed study of the accuracy of the method has not been made yet. Example 2: It is required to solve the first-order equa-

A simplified method...

tion with two non-linear terms

$$L(i)pi + r(i)i = [U_o], \quad (1)$$

where L(i) and r(i) are analytic functions given graphically or by formulas. A new time scale $\omega_o(t)$ is introduced. Hence one obtains

$$L(i)\omega_o'D + r(i)i = [U_o], \quad (2)$$

where D = d/dt. Choosing ω_o so that $L(i)\omega_o = r(i)$, one obtains the linear equation

$$(D + 1)\, i = \frac{1}{r(i)} [U_o] \quad (3)$$

whose solution is

$$i = \frac{U_o}{r(i)} \left(1 - e^{-\left(\frac{T}{\frac{L(i)}{r(i)}}\right)}\right) \quad (4)$$

Example 3: An equation with variable coefficients is solved:

Card 3/4

A simplified method...

$$[a_1(t)p + a_0(t)]i = [U_0] \qquad (5)$$

$a_1(t)$ being a given analytic function of time. A new time scale is introduced. Setting thereupon $a_1(t)\omega_0 = a_0 = \text{const} = 1$, and $\omega_0(t) = a_0/a_1(t)$, one obtains the linear equation

$$a_0(D + 1)i = [U_0]. \qquad (7)$$

This equation is solved and the sought-for function i(t) is found by means of a given table. The above method permits obtaining the general integral of equations (of any order) describing complex control systems, by determining the time dependence of all the variables of the system, unit by unit. There are 4 figures, 4 tables and 2 Soviet-bloc references.

SUBMITTED: March 10, 1961

Card 4/4

IVAKHNENKO, A. G.

29209

S/102/61/000/005/001/005
D274/D302

16.4000 (1031,1013)

AUTHOR: Ivakhnenko, O.G. (Kyyiv)

TITLE: Applying the theory of invariance and of combined control to the synthesis and analysis of learning systems

4

PERIODICAL: Avtomatyka, no. 5, 1961, 3 - 11

TEXT: The known control systems are analyzed to establish which of them would be suitable as learning systems and which -- as self-organizing systems, i.e. systems which could produce information. It is shown that learning systems, just as any other control system can be based on either of the two principles: 1) Open-loop control by disturbances (external signals), or 2) output-parameter feedback. Most convenient are combined systems, incorporating both principles. In learning systems, these principles are related to the inductive- and deductive method of logic, respectively. A classification of the various systems is shown in a figure. The systems may be also subdivided into determinate systems, purely statistical

Card 1/4

Applying the theory of ...

and probabilistic systems. The determinate systems include both open- and close-loop systems, but they do not include self-organizing systems. The statistical systems, on the other hand, are closed-loop only (i.e. deductive). Though open-loop statistical systems are possible, no one has proposed such systems yet. There are, among statistical systems, self-organizing ones. The statistical systems involve statistical (random) search. On the other hand, probabilistic systems which learn without statistical search, do so on the basis of not very accurate rules (algorithms). An example of an open-loop probabilistic system is Attley's conditional-probability system. An example of a closed-loop probabilistic system is Gordon Pask's system. Among general-purpose learning systems, O. Selfridge's "pandemonium" is noted as an example of an open-loop system, and F. Rozenblatt's perceptron as a combined system which has an open loop (for learning) and positive feedback (for self-organizing). A modified perceptron is proposed by the author. The main distinguishing features of this type are: a) The use of a maximum-voltage indicator for choosing the correct response; b) This voltage is formed as a result of matched operation

Card 2/4

Applying the theory of ...

of a direct-coupled and an inverted amplifier. Such a perceptron is readily adaptive. It learns by the inductive method, having an open-loop (whose role may be taken by man). Self-organization of the perceptron is effected by positive feedback or by statistical search. The entire self-organizing process takes place in several stages whose number does not exceed the number of signs (invariants) The process continues until maximum possible organization of elements is reached. It is noted that perceptrons are being designed with incomplete probabilistic input information and continuous (non-binary) signals which is of great practical importance. The use of invariance theory and combined control is very promising for perceptron systems; thus invariance theory permits reducing to a minimum (or zero) the number of switchings required for self-organizing. The conclusion is reached that invariance theory and combined control can be used for all types of learning systems, and that the only self-organizing systems are statistical systems and systems with positive feedback of perceptron type. It is noted that many scientific studies (e.g. automatic translation) are improper-

4

29209

S/102/61/000/005/001/005
D274/D302

Applying the theory of ...

ly conducted with respect to the use of self-organizing systems. There are 6 figures and 14 references: 7 Soviet-bloc and 7 non-Soviet-bloc (including 3 translations). The references to the 4 most recent English-language publications read as follows: H.F. George, Probabilistic Machines Automation Progress, no. 1, January 1958; L.H. Yong, Biological Systems Control Engineering, October 1960; J.V. Zettvin, H.R. Maturana, N.S. McCulloch, What the Frog's Eye Tells the Frog's Brain, Proceedings of the IRE, Nov. 1959; F. Rozenblatt, Two Theorems of Statistical Separability in the Perceptron, X Symposium on the Mechanization of Thought Process, England, Nov. 1959, Phys. Review, no. 65, 1958.

SUBMITTED: May 26, 1961

Card 4/4

PETROV, B.N.; SOTSKOV, B.S.; LARIONOV, A.N.; CHILIKIN, M.G.; SYROMYATNIKOV, I.A.; BLAGONRAVOV, A.A.; KRUZHILIN, G.N.; IVAKHNENKO, A.G.; NAGORSKIY, V.D.; CHELYUSTKIN, A.B.; DROZDOV, N.G.; PETROV, I.I.

Seventieth birthday of Viktor Sergeevich Kulebakin. Elektrichestvo no.10:90-91 O '61. (MIRA 14:10)
(Kulebakin, Viktor Sergeevich, 1891-)

S/194/62/000/010/019/084
A154/A126

9.2530

AUTHOR: Ivakhnenko, A.G.

TITLE: Stabilization of the characteristics of a measuring magamp by means of two differential feedbacks

PERIODICAL: Referativnyy zhurnal, Avtomatika i radioelektronika, no. 10, 1962, 14, abstract 10-2-28ye (Bul. Inst. politehn. Iaşi, 1961, 7, no. 1 - 2, 211 - 216; summaries in English, Rumanian)

TEXT: Differential control circuits are examined in which negative and positive feedbacks are fed simultaneously to the magamp input. Based on the invariance theory, a magamp circuit is analyzed by means of internal and external differential feedbacks. It was shown that with internal negative feedback and positive external feedback the magamp characteristics are considerably more stable than vice versa. There are 2 figures and 10 references.

V.Kh.

[Abstracter's note: Complete translation]

Card 1/1

IVAKHNENKO, Aleksey Grigor'yevich; ZAYTSEV, G., kand.tekhn.nauk,red.; POLYANSKAYA, L.O., ved.red.; MATUSEVICH,S.M., tekh. red.

[Technical cybernetics; automatic control systems with adapted characteristics] Tekhnicheskaia kibernetika; sistemy avtomaticheskogo upravleniia s prisposobleniem kharakteristik. 2. izd. Kiev, Gostekhizdat USSR, 1962. 421 p. (MIRA 15:7)
(Cybernetics) (Automatic control)

35212
S/102/62/000/001/002/007
D201/D303

16.8000 (1031, 1132, 1329)

AUTHOR: Ivakhnenko, A.G. (Kiyev)

TITLE: Relationships between the theory of invariance and statistical methods of control system analysis

PERIODICAL: Avtomatyka, no. 1, 1962, 13-23

TEXT: The author shows how statistical methods, in conjunction with the theory of invariance, may be applied to the design and analysis of compound multi-loop systems, for cases where the disturbances affect not the input, but directly the output stage of the system. The method described is called 'designing by parts' and is based on the superimposition principle. In the first stage of the 'design by parts' the statistical method is used to determine the parameters of the LHS of the equation of the system dynamics. The stability and the degree of the interference killing of the system are thus established (error minimization). The method of absolute invariance is used in the next step to compensate for errors. The method is applied to analyzing the following control systems: Open loop systems,

Card 1/3

Relationships between the ...

closed loop feedback with open-loop stabilization, single-loop feedback. Single-loop stabilization feedback, compound systems, multi-loop with no disturbance feed-forward. Analysis of the corresponding system equations shows that in stabilizing systems, with no first order disturbance feed-forward, two feedback loops are required for complete elimination of errors caused by the effects of disturbances due to noise at the input and load, but at least three feedback loops are required in a system to make it invariant to noise at the control section of the system. The number of errors which are to be minimized decreases with an increasing number of loops, the number of errors which may be eliminated increases, but all errors may be compensated for by an infinite number of feedback loops only. The method remains applicable in the case when the conditions for absolute invariance cannot be determined, i.e., when in practice only some of the differentials, required for error elimination, are given. In such a case as many as possible error components are eliminated in the first approximation, the rest being minimized. In the second approximation the coefficients of differentials are changed so as to result in a

Relationships between the ...

condition as near as possible to that of complete error elimination. There are 1 figure and 9 references: 6 Soviet-bloc and 3 non-Soviet-bloc. The reference to the English-language publication reads as follows: Ziegler and Nichols, Optimum setting for Automatic Controllers, Trans. of ASME, no. 8, 1942; Control, June 1961.

SUBMITTED: September 30, 1961

Card 3/3

RUBANIK, V.P., dotsent; IVAKHNENKO, O.G. [Ivakhnenko, O.H.]

Concerning a simplified method for solving nonlinear differential equations and equations with time-varying parameters. Avtomatyka no.1:93-94 '62. (MIRA 15:2)

1. Ispolnyayushchiy obyazannosti zaveduyushchego kafedroy Chernovitskogo universiteta (for Rubanik).
(Differential equations)

IVAKHNENKO, O.G.

S/102/62/000/003/003/005
D234/D308

16.8000

AUTHOR: Ivakhnenko, O.H.

TITLE: Self-organizing systems with positive feedback

PERIODICAL: Avtomatyka, no. 3, 1962, 33-50

TEXT: The author gives a survey of principles taken from existing literature, and two examples of self-organizing systems, one of which has been developed at the Instytut elektrotekhniky, AN URSR (Institute of Electrical Engineering of AS UkrSSR) and is intended for recognition of letters. The latter belongs to systems of the perceptron type with positive feedback securing self-learning after the image has been shown only once. Six different types of positive feedback are described. It is stated that the system is the more perfect and capable of self-organizing the larger the number of positive feedbacks in it. A mathematical appendix deals with 1) proof of continuous decrease of entropy (degree of the lack of organization) and the possibility of operation starting from zero organization in a system with statistical search, 2) same for a

Card 1/2

Self-organizing systems ...

system with positive feedback, 3) determination of efficiency and stability factors, 4) condition of efficiency of a system with two positive feedbacks in case of finite number of transmitters and relays, 5) analogy between conditions of invariance of control systems and self-organizing systems with positive feedback. G.V. Shchipanov is mentioned for his contributions in the field. There are 8 figures.

SUBMITTED: February 5, 1962

Card 2/2

IVAKHNENKO, A.G. [Ivakhnenko, O.H.]; SHLEZINGER, M.I.

Trends in the development of cybernetics. Avtomatyka 7 no.5: 78-91 '62. (MIRA 15:11)

(Cybernetics)

S/102/62/000/006/002/005
D201/D308

6.9200

AUTHOR: Ivakhnenko, O.G. (Kiev)

TITLE: The advantages of single-row pattern recognition adaptive systems

PERIODICAL: Avtomatyka, no. 6, 1962, 10-19

TEXT: The author briefly reviews the principles of pattern recognition adaptive systems and shows that the least number of associative cells required in a system in which the information at the input is divided into rows and a single row at a time is presented to it for recognition. A method for determining the "resolving power" of such a system is suggested and the principles of design of complex pattern recognition self-adapting systems are discussed. There are 4 figures and 1 table.

SUBMITTED: June 12, 1962

Card 1/1

IVAKHNENKO, A. G.

Machines "think" and guide.... Nauka i zhyttia 11 no.1:34-36 Ja '62. (MIRA 15:2)

1. Chlen-korrespondent AN USSR.
(Cybernetics)

S/025/62/000/011/003/005
D222/D308

AUTHOR: Ivakhnenko, A.G., Corresponding Member of the AS USSR

TITLE: Cybernetics and the reliability of space vehicle control systems

PERIODICAL: Nauka i zhizn', 29, no. 11, 1962, 30-31

TEXT: Methods of increasing the reliability of complex systems are discussed: duplication of components, functional abundance of elements, redistribution of functions, the synthesis of reliable systems from unreliable components.

Card 1/1

ACCESSION NR: AT4016407 S/3049/62/000/000/0088/0101

AUTHOR: Ivakhnenko, A. G.

TITLE: Inductive and deductive methods of knowledge as a foundation for the construction of two fundamental types of learning system

SOURCE: Printsipy* postroyeniya samoobuchayushchikhsya sistem (Principles of construction of self-instructing systems). Sbornik materialov simpoziuma, 1961. Kiev, Gostekhizdat UkrSSR, 1962, 88-101

TOPIC TAGS: self-instructing system, cybernetics, learning machine, control system, feedback

ABSTRACT: The concepts of system learning (instruction) and self-instruction are defined and distinguished. In this paper, all known learning systems are considered in order to determine which of them is capable only of learning (the process of the accumulation and processing of input information) and which are capable of self-instruction (that is, the generation of new information not capable of being derived from the information available to the "teacher"). In the second place, it is shown that, just as in all control systems, learning systems may be constructed according to two basic principles: 1) the principle of open control through disturbances (external signals); 2) the principle of feedback by output values. These

Card 1/2

ACCESSION NR: AT4016407

principles are related by the author to the logical categories of induction (open control) and deduction (closed control). A complete classification arrangement of cybernetic learning systems is developed and discussed in detail. Types considered include: determined learning systems, statistical learning systems, probabilistic systems without statistical search, the Attley conditional-probabilistic system, the "perceptron" (and the property of adaptation), and a number of others. The author clearly illustrates how, in the area of the development of learning machines, there is a conflict between two opposite scientific concepts: determinism and self-organization. The burden of the present work is to show how these concepts are not antagonistic, but rather reflect the factual properties of two radically different systems which implement: 1) the principle of open control through disturbances (signals); 2) the principle of feedback through output values (sum effect). In the theory of cognition, these two principles correspond to the inductive and deductive methods. Orig. art. has: 7 figures.

ASSOCIATION: none

SUBMITTED: 00 DATE ACQ: 06Jan64 ENCL: 00

SUB CODE: IE NO REF SOV: 009 OTHER: 004

Card 2/2

KULIK, Valeriy Timofeyevich; IVAKHNENKO, A.G., prof., retsenzent; IVANOV, V.V., kand. fiz.-matem. nauk, red.; NAVROTSKAYA, L.B., inzh., red.; STARODUB, T.A., tekhn. red.; MATUSEVICH, S.M., tekhn. red.

[Principles of algorithmation and construction of control machines] Printsipy algoritmizatsii i postroeniia upravliaiushchikh mashin. Kiev, Gostekhizdat USSR, 1963. 309 p. (MIRA 17:2)

1. Chlen-korrespondent AN Ukr.SSR (for Ivakhnenko)

IVAKHNENKO, Aleksey Grigor'yevich [Ivakhnenko, O.H.]; KOSTYUK, V.I., kand. tekhn. nauk, retsenzent; DEREVETS', S.K., red.izd-va; MATUSEVICH, S.M.[Matusevych, S.M.], tekhn. red.

[Cybernetic systems with composite control] Kibernetychni systemy z kombinovanym deruvanniam. Kyiv, Derzh.vyd-vo tekhn.lit-ry URSR, 1963. 486 p. (MIRA 17:3)

1. Chlen-korrespondent AN Ukr.SSR (for Ivakhnenko).

IVAKHNENKO, Aleksey Grigor'yevich; IMAS, R.L., red.; MONZHERAN, P.F., tekhn. red.

[Self-teaching systems with positive feedback] Samoobuchaiushchiesia sistemy s polozhitel'nymi sviaziami; spravochnoe posobie. Kiev, Izd-vo AN USSR, 1963. 327 p. (MIRA 16:11)

(Automatic control) (Information theory) (Electronic computers)

S/102/63/000/001/001/004
D201/D308

AUTHOR: Ivakhnenko, A.G. (Kiev)

TITLE: Conditions of absolute invariance and stability of self-adapting systems with probability loops

PERIODICAL: Avtomatyka, no. 1, 1963, 3-9

TEXT: The author derives and analyzes the conditions of absolute invariance and stability for the following systems with probability loops: (a) single-loop stabilization systems and (b) two-loop (differential) follow-up systems. Characteristic equations determining the stability are given and the transfer function of the probability loop is derived in operator form. It is shown that, knowing the transfer function of the probability loop, it is possible to design any of the discussed systems by choosing the parameters of the L.H.S. of the dynamic equation using the principle of the 'compromise' design and those of the R.H.S. according to the invariance conditions. The above principle is applied to the design of a system having one probability loop. There are 2 figures and 4 tables.

SUBMITTED: September 11, 1961

Card 1/1

IVAKHNENKO, A.G. [Ivakhnenko, O.H.]; KLESHCHEV, V.V. [Klieshchov, V.V.]; OTKHMEZURI, G.L. [Otkhmezuri, H.L.]; SHLEZINGER, M.I.

Fundamental work in the theory of perceptrons; a review of "Principles of neurodynamics", a book by F.Rosenblatt. Avtomatyka 8 no.3:84-90 '63. (MIRA 16:7)
(Perceptrons) (Cybernetics) (Rosenblatt, F.)

IVAKHNENKO, A.G. [Ivakhnenko, O.G.] (Kiyev)

Principles of the construction of self-teaching systems for the control of complex processes. Avtomatyka 8 no.4:17-31 '63. (MIRA 16:10)

L 12485-63 EWT(d)/FCC(w)/BDS ASD/ESD-3/APGC Pg-4/Pk-4/Po-4/Pq-4 GG/IJP(C)
S/102/63/000/002/004/007

AUTHOR: Ivakhnenko, O. H.

TITLE: Can a cognitive self-teaching system discriminate the moment of transformation of a tadpole into a frog?

PERIODICAL: Avtomatyka, no. 2, 1963, 31-40

TEXT: In observing the slow, one-sided process of transformation of a tadpole into a frog, definite changes of output reactions of the system must place. In the beginning one output is operating, but at a certain time another output must begin to operate, and then a third, etc., which reflects the process of observing metamorphosis. The problem is considered on how to define the moment of switching over which always occurs when the path of the pole becomes shorter than that of the point of intersection of the boundary of a given pole region with the trajectory of the representation in a multidimensional space of properties. The examples which are considered in this paper show that the moment of switching over dopends, to a great extent, on the positive feedback averaging law. The greater the weight of the previous measurement or the more "conservative" is the feedback and the rarer the moments when the measurements are taken the sooner the

Card 1/2

moment of switching occurs. The "Al'fa" system having a very "dependable" feedback which takes into account the last measurement only, cannot discriminate the moment of gradual transition of one form into another, as for example a tadpole into a frog. The article has 3 figures and 4 tables.

SUBMITTED: July 30, 1962.

IVAKHNENKO, A.G. [Ivakhnenko, O.H.] (Kiyev)

Composite (determined self-teaching) control systems for continuous processes. Avtomatyka 8 no.5:46-57 '63. (MIRA 17:1)

KULEBAKIN, V.S., akademik, otv. red.; PETROV, B.N., akademik, otv. red.; BODNER, V.A., doktor tekhn. nauk, red.; VORONOV, A.A., doktor tekhn. nauk, red.; IVAKHNENKO, A.G., red.; ISHLINSKIY, A.Yu., akademik, red.; KOSTYUK, O.M., kand. tekhn. nauk, red.; KRASSOV, I.M., kand. tekhn. nauk, red.; KUNTSEVICH, V.M., kand. tekhn. nauk, red.; KUKHTENKO, A.I., red.; RYABOV, B.A., doktor tekhn. nauk, red.; SIMONOV, N.I., doktor fiz.-mat. nauk, red.; ULANOV, G.M., doktor tekhn. nauk, red.; FEDOROV, S.M., kand. tekhn. nauk, red.; TSYPKIN, Ya.Z., doktor tekhn. nauk, red.; CHINAYEV, P.I., kand. tekhn. nauk, red.; KRUTOVA, I.N., kand. tekhn. nauk, red.; RUTKOVSKIY, V.Yu., kand. tekhn. nauk, red.

[Invariancy theory in automatic control systems; transactions] Teoriia invariantnosti v sistemakh avtomaticheskogo upravleniia; trudy. Moskva, Nauka, 1964. 503 p. (MIRA 18:2)

1. Vsesoyuznoye soveshchaniye po teorii invariantnosti i yeye primeneniyu v avtomaticheskikh ustroystvakh. 2d, Kiev, 1962. 2. Chlen-korrespondent AN Ukr.SSR (for Ivakhnenko, Kukhtenko).

ACCESSION NR: AP4013548 S/0102/64/000/001/0043/0058

AUTHOR: Ivakhnenko, O. G. (Ivakhnenko, A. G.) (Kiev); Finogyeyeva, G. G. (Finogeyeva, G. G.) (Kiev)

TITLE: Problem of constructing a (determinate and self-learning) medical-treatment system

SOURCE: Avtomaty*ka, no. 1, 1964, 43-58

TOPIC TAGS: automated medical treatment, medical treatment, automated therapy, automatic therapeutic system, self-learning automatic system, determinate automatic system

ABSTRACT: The problem of creating a medical-treatment (therapeutic) system is considered; the system would consist of both diagnostic apparatae and treatment proper apparatae. Each of the two parts can be either determinate (man-preset) or self-learning; it can also combine both features. Examples of schemes of integrating storage devices, discriminators, treatment "machine," etc., are given. Previously-described (G. Ivakhnenko, "Avtomaty*ka," no. 4, 1963)

Card 1/2

ACCESSION NR: AP4013548

irreversible systems with one maximum-voltage indicator are recognized as unsuitable for therapeutic purposes since they require higher initial settings, which is not permissible in therapeutic applications. Hence, a new "reversible" system is advanced which includes both a maximum-voltage and a minimum-voltage indicator. Its algorithm involves: (1) Only one indicator is functioning at one time; (2) The maximum-voltage indicator is turned on only in case the setting of the storage device is higher than the actual evaluation of the system state; (3) Conversely, the minimum-voltage indicator is turned on when the storage-device setting is lower than the voltage of the "quality sensor." Orig. art. has: 7 figures and 4 tables.

ASSOCIATION: none

SUBMITTED: 21Jun63	DATE ACQ: 14Feb64	ENCL: 00
SUB CODE: IE	NO REF SOV: 007	OTHER: 001

Card 2/2

ACCESSION NR: AP4040516 S/0102/64/000/003/0023/0040

AUTHOR: Ivakhnenko, O. G. (Ivakhnenko, A. G.) (Kiev); Voronova, L. I. (Kiev)

TITLE: Recognizing system Alpha as a learning filter and as an extremum controller without hunting

SOURCE: Avtomaty*ka, no. 3, 1964, 23-40

TOPIC TAGS: automatic control, on off automatic control, Alpha automatic control, pattern recognition

ABSTRACT: A further discussion of the possible characteristics of a self-learning automatic system suggested by the author (Avtomatika, no. 3, 1962) is presented. The following claims are laid: The binary on-off "Alpha" system is not only able (without human intervention) to recognize patterns but also to organize an extremum-control system. The only human guidance required is the selection of an extremum-performance-index sensor and the affirmation of the existence of a one-extremum characteristic. The complexity of the plant (number of control variables) does not limit the system. Learning (changing pole

Card 1/2

L 19451-65 EWT(d)/EPF(n)-2/EWP(1) Po-4/Pq-4/Pr-4/Ps-4/Pk-4/P2-4 [illegible]
ACCESSION NR: AP4041149 S/0202/64/[illegible]

AUTHOR: Ivakhnenko, O. G. (Ivakhnenko, A. G.) (Kiev)

TITLE: Comparing characteristics of fundamental types of combined extremal control. Part 2

SOURCE: Avtomaty*ka, no. 5, 1964, 43-54

TOPIC TAGS: automatic control, automatic control design, automatic control system, automatic control theory, extremal control

ABSTRACT: Three types of correctors influencing the open-loop characteristic are considered: (1) A correlation extremal corrector that does not require any trial steps in the plant. (2) A corrector with an averaging "evaluation matrix". (3) A discriminating system. The simplest algorithm of the functioning of a searchless corrector is determined. The most economical algorithm for identifying a model with the plant (a reversing sequential search) is found. A

Card 1/2

L 19451-65
ACCESSION NR: AP4049189

self-learning algorithm of the discriminator is also determined which the system uses in learning how to correctly discern the levels of the plant extremal characteristic and how to control the plant. When the shape of the extremal hill varies, the discriminator's learning should be changed. If it takes too long a time, the conventional search of extremum should be used. Therefore, the search function remains in the system but is used only under unusual conditions. The self-adjusting program of an open loop is considered. Orig. art. has: 7 figures and 8 formulas.

ASSOCIATION: none

SUBMITTED: 30Mar64 ENCL: 00

SUB CODE: IE NO REF SOV: 015 OTHER: 002

Card 2/2

IVAKHNENKO, A.G. [Ivakhnenko, O.H.] (Kiyev); KOMAROV, B.A. [Komarov, B.O.] (Kiyev)

Undercompensation, absolute invariance and overcompensation in automatic control systems. Avtomatyka 9 no. 2:16-32 '64. (MIRA 17:5)

IVAKHNENKO, O.G. [Ivakhnenko, O.H.]

Simulation of processes in neuron networks. Avtomatyka 9 no. 2: 82-88 '64. (MIRA 17:5)

IVAKHNENKO, A.G.; KLESHCHEV, V.V.; OTKHMEZURI, G.L.; SHLEZINGER, M.I.

First monograph on the theory of perceptrons (review of F. Rosenblatt's book "Principles of neurodynamics.") Avtom. upr. i vych. tekh. no.6:332-349 '64. (MIRA 17:10)

ACCESSION NR: AP4042953 S/0102/64/000/004/0015/0029

AUTHOR: Ivakhnenko, O. G. (Kiev); Ivakhnenko, A. G. (Kiev)

TITLE: Comparison of characteristics of fundamental schemes of combined optimum control

SOURCE: Avtomaty*ka, no. 4, 1964, 15-29

TOPIC TAGS: automatic control, automatic control design, automatic control system, automatic control theory, optimum control

ABSTRACT: In solving the problem of optimum control of a complicated continuous plant, no single system or single algorithm is sufficient. A combined use of several systems or algorithms is necessary, which results in a combined, determinate-self-learning system. Five such systems are considered: (1) An open-loop control with the disturbing variables converging toward a generalized disturbance and with the amplification level depending on the value of this

Card 1/3

ACCESSION NR: AP4042953

disturbance; (2) A no-search teaching optimum controller; (3) A teaching plant model of the "estimator matrix" type (a positional self-learning system); (4) A teaching plant model represented by a discriminating system (a rate self-learning system); (5) A self-resetting (automatic putting in operation) of the open-loop part which includes plant no-load and plant full-load experiments. The algorithms involved are based on these two fundamentals: (a) an open-loop determinate member cannot provide good control without a teaching corrector and (b) the teaching member (corrector) is practically inoperative without the open-loop member. In synthesizing the system, all data obtained from studying the plant should be used; but it is a foregone conclusion that a corrector will still be needed. Only in a combined system can the open-loop part be approximated fairly close (the closer, the smaller the corrector), and a no-search teaching correlation optimum controller becomes feasible. With the present state of affairs, a search (trials on the plant) is not permissible. A teaching optimum controller can be replaced with a teaching plant model, in which (very different from searching) processes of identifying the model and the plant take place. The "estimator matrix" -- and

Card 2/3

ACCESSION NR: AP4042953

with some types of disturbance, the discriminating schemes -- is recommended; the latter are based on the algorithm of maximization of scalar products or on the algorithm of minimization of the square of distances to the pole. Orig. art. has: 6 figures, 22 formulas, and 5 tables.

ASSOCIATION: none

SUBMITTED: 23Mar64 ENCL: 00

SUB CODE: DP, IE NO REF SOV: 015 OTHER: 002

Card 3/3

BOYCHUK, Leonid Mikhaylovich; IVAKHNENKO, A.G., otv. red.;
YEVSEYENKO-MISYURENKO, I.V., red.

[Optimum automatic control systems] Optimal'nye avtomatícheskogo regulirovaniia. Kiev, Naukova dumka, 1965. 81 p. (MIRA 18:4)

1. Chlen-korrespondent AN Ukr.SSR (for Ivakhnenko).

SUKHOMLINOV, Maksim Maksimovich, kand. tekhn. nauk; VYKHOVANETS, Vitaliy Ivanovich, inzh.; KATKOV, F.A., doktor tekhn. nauk, retsenzent; DIDYK, B.S., inzh., retsenzent; IVAKHNENKO, A.G., red.

[Number code converters] Preobrazovateli kodov chisel. Kiev, Tekhnika, 1965. 135 p. (MIRA 18:4)

1. Chlen-korrespondent AN Ukr.SSR (for Ivakhnenko).

Author [illegible]

Title [illegible] as training correctors in optimum control

SOURCE: Avtomatyka, no. 3, 1965, 55-72

TOPIC TAGS: automatic control, pattern recognition, optimal control

[illegible] correlational (regressional) analysis can be used only for [illegible] because of the time that is [illegible] self learns a criterion. The system distinguishes situations by simple proper- [illegible] much shorter time. New definitions for the con- cept "state" (or "pattern") and "situation" (or "stimuli") are introduced, and the

Card 1/2

ACCESSION NR: AP5016379

composition of a set of input symbols is found. As an illustration, the author
[illegible] useful (informative) signs according to the "resolving
[illegible] figures, 2 tables.

SUB CODE: EP

OTHER: 004

Card 2/2

IVAKHNENKO, Aleksey Grigor'yevich; LAPA, Valentin Grigor'yevich; IMAS, R.L., red.

[Cybernetic predictive systems] Kiberneticheskie predskazyvaiushchie ustroistva. Kiev, Naukova dumka, 1965. 213 p. (MIRA 19:1)

L 25646-66 EWT(1) GW

ACC NR: AM6008535 Monograph UR/

Ivakhnenko, Aleksey Grigor'yevich; Lapa, Valentin Grigor'yevich

Cybernetic forecasting devices (Kiberneticheskiye predskazyvayushchiye ustroystva) Kiev, Naukova dumka, 1965. 213 p. illus., biblio. (At head of title: Akademiya nauk Ukrainskoy SSR) 18,000 copies printed.

TOPIC TAGS: cybernetics, control statistics, error prediction, mathematic prediction, mathematic logic, stochastic process, random process

PURPOSE AND COVERAGE: This book is intended for specialists working in various fields of science and engineering who are concerned with statistical forecasting methods and their practical application. The book presents certain theoretical problems in forecasting determined and stochastic processes. Special attention is given to various forecasting algorithms using electronic digital computers. The problems of applying cognitive systems, such as the "Alfa" system, to forecasting filters are emphasized. The examples are taken from the chemical industry, biology, ocean-turbulence processes, forecasting fluctuations in river flow, and from other fields. The question of forecasting filters furnishing the only possibility for

Card 1/4

coconstructing or control system for periodical processes is also discussed. There are 62 references of which 47 are Soviet and 15 are non-Soviet.

TABLE OF CONTENTS:

L 25646-66

ACC NR: AM6008535

Card 3/4

L 25646-66

ACC NR: AM6008535

Cybernetic forecasting filters -- 206

Bibliography -- 208

SUB CODE: 06/ SUBM DATE: 24Nov65/ ORIG REF: 045/ OTH REF: 017

Card 4/4 FV

L 02444-67 EWT(d)/T/EWP(1) IJP(c) GG/BB

ACC NR: AP6018018 SOURCE CODE: UR/0102/66/000/003/0024/0034

AUTHOR: Herhey, T. -- Gergey, T. -- Gergely, T. (Hungary); Ivakhnenko, O. H. -- Ivakhnenko, A. G. (Kiev); Lemishevs'kyy, H. A. -- Lemishevskiy, G. A. (L'viv)

55
B

ORG: None

TITLE: Selecting the "style" or "language" of random perceptron prototypes

SOURCE: Avtomatyka, no. 3, 1966, 24-34

TOPIC TAGS: pattern recognition, perceptron, switching circuit

ABSTRACT: The authors consider the problem of choosing the "style" or "language" of random masks of a perceptron with a known style of perceived images. The concept of style does not have a mathematical characteristic. Thus this experimental study does not pretend to be rigorous, but qualitative. A diagram and the components of the perceptron are given. A four-row perceptron with two rows of controlled connections is considered. Blotched and striated negatives are used as input images and random masks are superimposed over them. A uniform light source is used for illumination. Photocells are used to measure the amount of light passing through the negatives. The opaque spots on the negatives cause the first row of perceptron elements to switch off, while transparent sections keep these switches closed. Thus the pattern of the mask causes an adjustment in the first row of the controlled connections. The light

Card 1/2

L 02444-67

ACC NR: AP6018018

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intensity at each point of the image serves as the mark in conformity with the classical perceptron of F. Rozenblat. If the image and the prototype are the same, then the maximum value of the light beam equals 50%. If there is a significant difference between image and prototype, light intensity decreases. The selection of dimensions for random prototype elements is considered. Point and curvilinear random masks are studied. The optical perceptron was used for recognizing two classes of spotted images, two classes of striated images and a class of mixed striated and spotted images. Both point and curved random prototypes were used in all three cases. The results show that point random prototypes should be used for recognizing spotted images such as a leopard skin. Curved prototypes produce better results than point prototypes for recognizing striated images such as zebra or tiger skins. In recognizing mixed striated and spotted images, a 50-50 combination should be used. This will produce maximum recognition by the perceptron. Orig. art. has: 6 figures, 10 tables, 6 formulas.

SUB CODE: 06, 09/ SUBM DATE: 18Feb66/ ORIG REF: 002

Card 2/2 gd

L 09916-67

ACC NR: AP6034640 SOURCE CODE: UR/0102/66/000/004/0026/0039

29

AUTHOR: Ivakhnenko, O. H. -- Ivakhnenko, A. G. (Kiev)

ORG: none

TITLE: Criterion of the number of resolvable arguments for selection of useful signs for recognition and prediction systems

SOURCE: Avtomatyka, no. 4, 1966, 26-39

TOPIC TAGS: recognition process, mathematic prediction, recognition system, prediction system, algorithm, dynamic programming

ABSTRACT: The author has developed a criterion of resolvable arguments for the selection of the most useful signs in recognition and prediction systems. The criterion makes is possible to find the minimum number of primary sensor units with which all images of the learning sequence can be divided with a multiple equal to unity. It is shown that the application of generalized signs (products of primary signs) does not change the selection of sensor units and can be used only to increase the multiplicity of resolution of the arguments to the value of $q = 2^{n-1}$, where n is the number of sensor units. Thus, the selection of primary

Card 1/2

signs has as its aim finding the minimum set of signs with the multiple equal to unity. The selection of generalized signs has as its aim finding sets with any required multiplicity less than $q = 2^{n-1}$. Algorithms of searching are proposed which are analogous to the method of dynamic programming. These methods reduce considerably the volume of selection of probable combinations of signs for the selection of these two sets. Orig. art. has: 2 figures and 9 tables. [Based on author's abstract]

SUB CODE: 12, 13/SUBM DATE: 28Jun66/ ORIG REF: 002/

L 08723-67 EWT(d)/EWP(1) IJP(c) BB/GG
ACC NR: AP6033623 SOURCE CODE: UR/0102/66/000/005/0028/0036

AUTHOR: Ivakhnenko, O. H. -- Ivakhnenko, A. G. (Kiev) 25

ORG: none

TITLE: Indetermined character recognition 16 system

SOURCE: Avtomatyka, no. 5, 1966, 28-36

TOPIC TAGS: cognitive system, perceptron, character recognition, cognition

ABSTRACT: The author explains the adequacy of the general law governing the recognition or control part of a character recognition system. The probability characteristics of both parts of a system must be equal for perfect cognition or control. The probability characteristics of random prototypes of perceptrons or ordinary cognitive systems should be identical to the probability characteristics of the recognized images. The author proposes a cognitive system with changing random prototypes which surpasses other perceptrons in cases when the classified properties of the images are unstable and variable. Orig. art. has: 5 figures.

SUB CODE: 06,09/ SUBM DATE: 21Jun66/ ORIG REF: 004/ OTH REF: 003/

Card 1/1 nst

ACC NR: AP6018324 SOURCE CODE: UR/0102/65/000/006/0012/0029

AUTHOR: Ivakhnenko, O. H.-- Ivakhnenko, A. G. (Kiev)

ORG: none

TITLE: Efficient selection of connecting resistors and number of units in the layers of a four layer perceptron 16

SOURCE: Avtomatyka, no. 6, 1965, 12-29

TOPIC TAGS: perceptron, cybernetics, system design, self organizing system, learning process

ABSTRACT: This work proposes a method of efficient selection of connecting resistance bases on the 'pole gas' concept. From the exposition it follows that purely analytical methods cannot be used when investigating highly complex cybernetic systems. Ordinarily, the use of analytic investigators is desirable, but in most cases cybernetic systems are so complex that strictly analytic methods are inapplicable. The attempt to replace an analytical and experimental study based on purely qualitative considerations with a study supported by precise calculations and computations greatly impeded perceptron theory in the Soviet Union, because pessimistic conclusions in regard to the simplest perceptrons with one prototype for each pattern overshadowed the field as a whole. Far more effort was devoted to criticism of the Rosenblatt theorem on the congruence of learning processes than to the further development of the qualitative theory of complex perceptron systems. The problem of

Card 1/2

ACC NR: AP6018324

the efficient selection of connecting resistors and number of units in the layers of a four layer perceptron has not been resolved, the present authors, however, propose certain rules for organizing the second and third layers of perceptron units. In four layer perceptrons there is an optimum number of units in the second layer, to exceed which lowers the self learning process, and to exceed which makes pattern discrimination impossible. The number of elements in the third layer equals the product of the number of poles by the number of perceptron outputs, whereas connection resistances are chosen to obtain maximum definition of the output comparator used instead of threshold elements in the third layer. The rules proposed permit a deterministic (precisely calculated) solution. Orig. art. has: 30 formulas, 3 tables, and 5 figures.

SUB CODE: 05,09/ SUBM DATE: 28Sep65/ ORIG REF: 006/ OTH REF: 001

Card 2/2

ACC NR: AT6022683 SOURCE CODE: UR/0000/66/000/000/0135/0147

AUTHOR: Ivakhnenko, A. G.

ORG: none

TITLE: Combined (deterministic - self-teaching) control systems for complex processes

SOURCE: Moscow. Institut avtomatiki i telemekhaniki. Samoobuchayushchiyesya avtomaticheskiye sistemy (Self-instructing automatic systems). Moscow, Izd-vo Nauka, 1966, 135-147

TOPIC TAGS: optimal control, adaptive control, self adaptive control, deterministic system, self teaching system

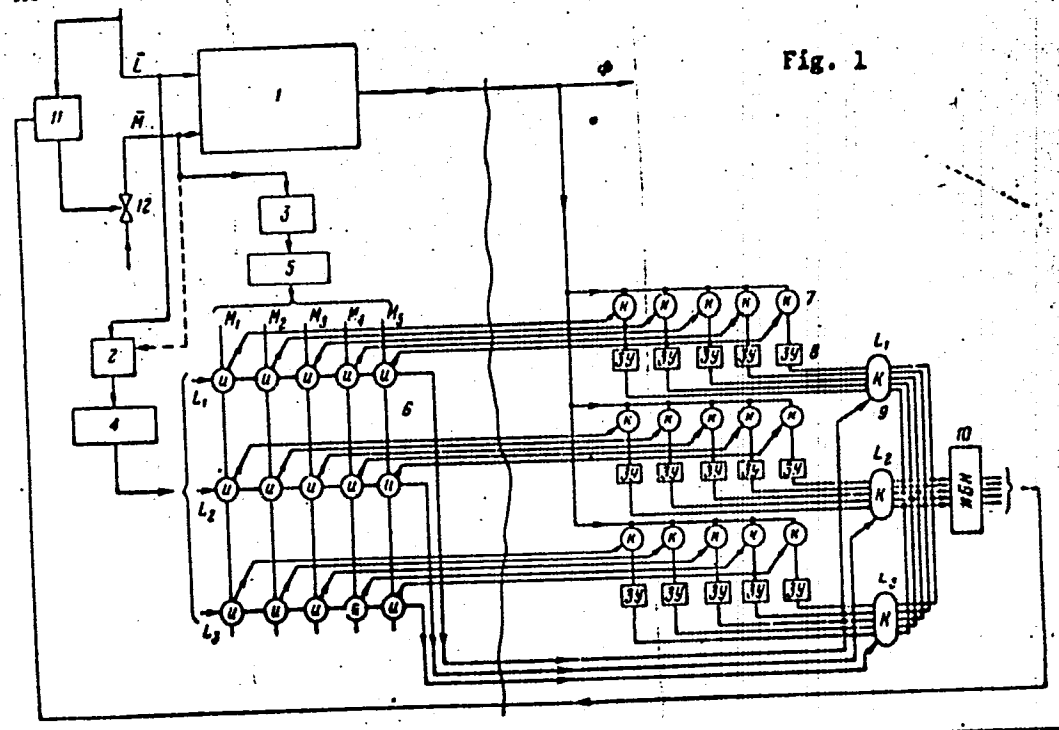
ABSTRACT: This paper deals with self-adaptive automatic control systems based on comparison of a process quality indicator with a stored ideal process model. Since all ideal process reference values are available simultaneously, the search phase needed in the conventional self-adaptive control system is eliminated; instead, an almost instantaneous selection of an optimal mode of operation is achieved. The problem of "identification", i. e., the maintenance of correspondence between the model and the process, remains. The control system shown in Figure 1 is called *combined*, because it responds not only to the output variable and the control actions, but also to various disturbances. In this system the identification modules (4,5) control via gates (7)

Card 1/4

the connections from the process quality indicator to the memory (8). Gates (9) select the optimal mode of operation and, through the maximum voltage indicator (10), control the servosystem (11), which in turn operates control mechanisms (12). The latter regulate the operation of the object (1). The identification module (4) receives the information on disturbances in digital form, determines the operational status of the system and, by comparing this status with stored information for similar conditions, recognizes the *operational situation*. For each situation there is a corresponding output from the identification module. The analogy between this process and pattern recognition is obvious. A drawback of this system is the constraint that the process quality indicator value should always be lower than the reference value. If the desired process quality is time dependent, it is possible for the process quality indicator value to exceed that of the reference. Since this system is non-reversible it will, under these conditions, no longer provide optimal process control. A *reversible system* provides the answer to this problem. This system includes a minimum voltage indicator in addition to the maximum voltage indicator. Both indicators are controlled by a cyclic multivibrator, such that a certain mode of operation is realized until no further improvement in process quality results. While the non-reversible system is aperiodic, the reversible system is oscillatory. During the occurrence of damped oscillations the system changes its mode of operation between the maximum and the minimum voltage indicator regimes. Complex processes, such as steel production or treatment of illnesses, cannot be controlled on the basis of a single quality reference index. These are noncontinuous processes characterized by various discrete

ACC NR: AT6022683

Fig. 1



Card 3/4

ACC NR: AT6022683

cycles. While a continuous process can be described by a point in the parameter space, a cyclic noncontinuous process is described by a curve. Though control of such processes is much more complex, the basic principles of combined self-adaptive control, described above, are applicable. Three methods for recognition of *situations* in the coordinate space are discussed: 1. Analysis of all coordinate values with respect to a common scale. This method is not acceptable because of the excessive amount of equipment required and the poor utilization of the systems. 2. Deterministic non-uniform scale division for a limited region of parameter variations. 3. Utilization of the "alpha" system which is based on self-instruction of associative cells. Numerical examples of the processes of self-instruction for the various systems described are treated in the appendices. Orig. art. has: 7 figures.

SUB CODE: 13/ SUB M DATE: 02Mar66/ ORIG REF: 016/ OTH REF: 001

Card 4/4

ACC NR: AP6024366 SOURCE CODE: UR/0280/66/000/002/0077/0085

AUTHOR: Ivakhnenko, A. G. (Kiev); Voronova, L. I. (Kiev)

ORG: none

TITLE: The recognition system as a prediction filter

SOURCE: AN SSSR. Izvestiya. Tekhnicheskaya kibernetika, no. 2, 1966, 77-85

TOPIC TAGS: recognition process, pattern recognition, mathematic prediction, therapeutics / / Alpha recognition system

ABSTRACT: It is shown that the Alpha positive-feedback perceptron-type -- or with a corresponding computer program -- recognition system (Ivakhnenko, A. G. Samoobuchayushchiyesya sistemy s polozhitel'nymi obratnymi svyazyami. Izd-vo An UkrSSR, 1963) with classification of states according to output quantities may be employed as a adaptive prediction filter. This is exemplified by the utilization of this system to predict steady-state processes such as ocean wave amplitudes (Fig. 1) on using the following sequence of discrete values (the Kolmogorov formula)

$$O[f(t)] = \sum_{i}^{N} f_i r_i + \sum\sum f_{i_1} f_{i_2} r_{i_1} r_{i_2} + \sum\sum\sum f_{i_1} f_{i_2} f_{i_3} r_{i_1 i_2 i_3} + \ldots \quad (1)$$

Card 1/4

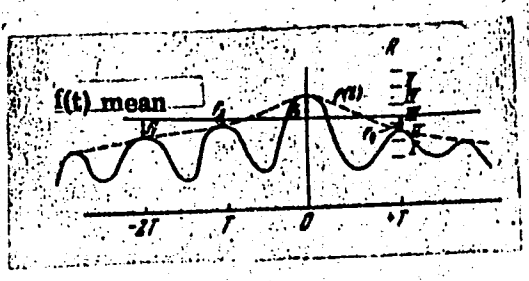


Fig. 1. Problem of predicting the amplitude of the following wave according to the amplitudes of the three preceding waves

(where f_n, f_{n1}, etc. are discrete values of the function in the past; r_n, r_{n1n2}, etc. are the weight coefficients of each term; $0[f(t)]$ is the predicted future value of the function; and N is the number of intervals of the prehistory) as the basis for selecting the features of the input images. In this case the input quantities (image features) for the Alpha system used as a prediction filter (Fig. 2) are the deviations f_1, f_2, f_3 and the problem is to predict the deviation f_4 (Fig. 1). It is shown that the percentage of correct predictions increases with both the increase in the number N of observed intervals and in the number n of discretizators and decreases with the increase in the number R of output (number of levels of discretization). In its simplified binary form (Fig. 3) this system displays the following advantages: 1) the need to operate only

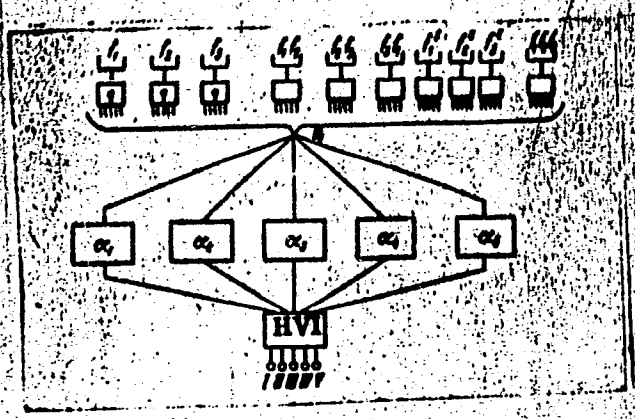


Fig. 2. The Alpha recognition system as a prediction filter

v_1 - input image; α_1 and α_2 groups of associating cells; HVI - higher voltage indicator

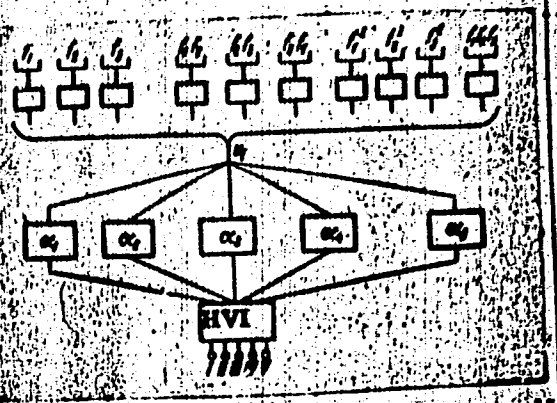


Fig. 3. The Alpha simplified binary prediction system

ACC NR: AP6024366

with the quantities +1 and -1, i.e., in the event of realization of the system, the simplicity of its relay design; 2) the possibility of predicting not only processes depicted by curves but also cyclic processes such as, e.g. the prediction of the outcome of treatment of patients. Characteristically, in this case the only information is the presence or absence of a feature. Hence, the Kolmogorov formula (as applied to the discrete Alpha filter) may also be extended to such prediction problems and, e.g. may account for and hence also condition the success of many prediction experiments. Thus, e.g. Brailovskiy and Lund (Avtomatika, 1964, no. 2) utilized twelve input features in their experiments to predict the outcome of the treatment of burns: surface area of wound, location of burn, degree of burn, age of the patient, attendant diseases, complications, data of blood and urine analysis, etc., utilized separately as well as in combinations of two, three, etc. Orig. art. has: 1 formula, 7 figures, 2 tables.

SUB CODE: 09, 12/ SUBM DATE: 17Apr64/ ORIG REF: 005/ OTH REF: 003

Card 4/4

L 18258-63 EWP(q)/EWT(m)/BDS AFFTC/ASD JD/RDW

ACCESSION NR: AP3002127 S/0185/63/008/006/0703/0704

AUTHOR: Sydyakin, V. H., Ivakhnenko, G. K.

TITLE: Electrical properties of selenium containing bismuth and tin impurities

SOURCE: Ukrains'kyy fizichnyy zhurnal, V. 8, no. 6, 1963, 703-704

TOPIC TAGS: conductivity, selenium, bismuth, tin, band theory, electrical property, powder metallurgy, structural model

ABSTRACT: Despite the large number of investigations of selenium, the problem of the mechanism of its conductivity and of its own structure has not yet been solved. The author approached this problem by investigating the effect of bismuth and tin on the electrical properties of selenium, in powder-metallurgy techniques. Specimens of selenium containing from 0.5 to 10% Bi and Sn impurities were prepared and measured by techniques described by Romankevich, V., and Sydyakin, V. H. (Izv. vuzov, Fizika, No. 3, 1960). Results are summarized in a graph (Enclosure 1) and a table (Enclosure 2). The graph shows that the total impurity does not greatly affect the conductivity of selenium, and the table shows that Alpha increases with increasing temperature. As for the effect of the percentage of impurities on the value of Alpha, it is much greater than on the value of Sigma.

Card 1/4

L 18258-63

ACCESSION NR: Ap3002127

Another conclusion is that the band theory cannot account for these experimental facts which, however, can be explained by the structural model (layer lattice) of selenium. Orig. art. has: 1 graph and 1 table.

ASSOCIATION: Ky'yivs'ky'y Ordena Lenina Politekhnichny'y Instytut.
(Kiev Order of Lenin Polytechnic Institute)

SUBMITTED: 2 Jan 63 DATE ACQ: 12 Jul 63 ENCL: 02

SUB CODE: PH NO REF SOV: 006 OTHER: 000

Card 2/4

L 34859-66 EWT(1)/T IJP(c) AT
ACC NR: AP6010056 (N) SOURCE CODE: UR/0032/66/032/003/0300/0302

AUTHOR: Ivakhnenko, G. K.; Sidyakin, V. G. 35 B

ORG: Kiev Polytechnic Institute (Kiyevskiy politekhnicheskiy institut)

TITLE: Method for investigating the inhomogeneity of semiconductor specimens

SOURCE: Zavodskaya laboratoriya, v. 32, no. 3, 1966, 300-302

TOPIC TAGS: semiconducting material, semiconductor research, DIELECTRIC CONSTANT, ELECTRIC CONDUCTANCE

ABSTRACT: A method is suggested for determining the inhomogeneity of two-phase semiconductor materials by measuring their absorption factor during high-voltage polarization. The fall-off of the current flowing in a semiconductor specimen is due to: (1) A weak-bond-ion polarization and (2) A high-voltage polarization owing to charge accumulation at the interface between the two phases that have different dielectric constants and conductances. The specimen is

Card 1/2 UDC: 537.311.33

L 34859-66
ACC NR: AP6010056

charged to a potential U_{ch}, then momentarily short-circuited (to relieve it from the geometrical-capacitance charge), and then its maximum recovery voltage U_r is measured. The absorption factor is given by: $K_a = U_r / U_{ch}$. The method was verified by measuring the absorption factors of amorphous and crystalline Se with different admixtures of iodine (numerical data reported). The error of the method depends on the error of measurement of U_{ch}. Orig. art. has: 3 figures, 3 formulas, and 1 table.

SUB CODE: 09 / SUBM DATE: none / ORIG REF: 004 / OTH REF: 001

Card 2/2 vmb

GILLER, A.S., veterinarnyy vrach; IVAKHNENKO, G.M., veterinarnyy vrach.

Experiment of using pentothal sodium on horses. Veterinariia 31 no.12:47 D '54. (MLRA 7:12)

1. Skolevskaya rayvetlechebnitsa, Drogobychskoy oblasti.
(PENTOTHAL SODIUM) (HORSES--DISEASES)

ACCESSION NR: AP4013085 S/0125/64/000/002/0072/0074

AUTHOR: Panin, V. V.; Borovskiy, O. B.; Ivakhnenko, I. S.; Iodkovskiy, S. A.

TITLE: Behavior of a drop and the liquid-puddle surface in electroslag remelting

SOURCE: Avtomaticheskaya svarka, no. 2, 1964, 72-74

TOPIC TAGS: remelting, electroslag remelting, molten metal drop, metal puddle, welding

ABSTRACT: An experimental x-ray investigation of the processes of formation of a molten-metal drop, its motion in the slag, and the behavior of the liquid-metal puddle is reported. Type 30 and 1Kh18N12 steels were remelted in an aluminum single-wall crystallizer of 80-mm ID, cooled by a water drain. Flux ANF-6 was used in 10 melts, and OSTs-45, in 2 melts; electrode diameter, 30-45 mm; carbon and austenitic steels were remelted. Twin electrodes, one

Card 1/2

ACCESSION NR: AP4013085

current-carrying and the other nonenergized, or one consumable (steel) and the other nonconsumable (tungsten), were used to study the effect of the current on the size of the drop. Upon a fusing of the flux, discharges occur between the electrode and the starter; this is accompanied by a rapid emission of 10-15-mm drops. Details of visually observable phenomena are given, as well as two pictures of the arc. Orig. art. has: 2 figures.

ASSOCIATION: TsNIITmash (Central Scientific-Research Institute of Heavy Machine Building)

SUBMITTED: 01Feb63 DATE ACQ: 26Feb64 ENCL: 00

SUB CODE: ML NO REF SOV: 000 OTHER: 000

Card 2/2

PANIN, V.V.; BOROVSKIY, O.B.; IVAKHNENKO, I.S.; IODKOVSKIY, S.A.

Behavior of a drop and a liquid bath surface during electric slag remelting. Avtom. svar. 17 no.2:72-74 F '64.
(MIRA 17:9)

1. TSentral'nyy nauchno-issledovatel'skiy institut tekhnologii i mashinostroyeniya.

84-5-6/42

AUTHOR: Ivakhnenko, K., Engineer, (Tbilisi)

TITLE: Crop Protection (Na zashchite urozhaya)

PERIODICAL: Grazhdanskaya Aviatsiya, 1957, Nr 5, p. 6 (USSR)

ABSTRACT: In the fertile Shirak Steppe, 150 to 180 pounds of winter wheat are collected per hectare. About 1/3 of the whole yearly wheat supply of the Georgian SSR comes from that area. In February 1957, the crops started to ripen two months ahead of time, and were attacked by the wheat beetle. The flight unit of agricultural aviation headed by Gelashvili was well prepared to exterminate the pest. A prominent part in the preparations is ascribed to the flight element commander Sikharulidze. The first to arrive at Shirak Steppe was the squad under Machabeli, with pilots Ushanga Gambarov and Albert Nutsubidze, and aviation technicians Dudarev and Prozorov. They started to spray the crops with hexachlorane. In the beginning of March, however, the work had to be stopped because of frost and snowfall. The crews switched over to fertilizing operations. By the beginning of April, pilot Gambarov had treated 1960, Nutsubidze 1370 hectares, for wheat beetle or fertilizing. Photo showing pilot Nutsubidze.

AVAILABLE: Library of Congress

Card: 1/1

IVAKHNENKO, M.M.

Automatic scales in foundry practice. Lit.proizv. no.4:11-12 Ap '63.
(MIRA 16:4)
(Scales (Weighing instruments))(Foundries—Equipment and supplies)

IVAKHNENKO, M.M.

Automatic error compensator for the weighing with a batcher.
Izm. tekh. no.10:23-27 O '63. (MIRA 16:12)

IVAKHNENKO, M.M.

Stabilizing the use of liquid metal by weight. Lit. proizv. no.10: 17-19 O '63. (MIRA 16:12)

IVAKHNENKO, M.M.

Prospects for using weight measuring feeders for molten meta:.
Lit. proizv. no.1:9-10 Ja '65. (MIRA 18:3)

ATROSHCHENKO, V.I.; IVAKHNENKO, M.T.; KONVISAR, V.Z.

Studying the sieve plates for the absorption of nitrogen oxides. Khim. prom. 42 no.9:678-680 S '65. (MIRA 18:9)

1. Khar'kovskiy politekhnicheskiy institut imeni Lenina i Lisichanskiy khimicheskiy kombinat.

ACCESSION NR: AP4026840 S/0102/64/000/002/0016/0032

AUTHOR: Ivakhnenko, O. G. (Kiev); Komarov, B. O. (Kiev)

TITLE: Undercompensation, absolute invariance, and overcompensation in automatic-control systems

SOURCE: Avtomaty*ka, no. 2, 1964, 16-32

TOPIC TAGS: automatic control, automatic control error undercompensation, automatic control error overcompensation, automatic control invariance, automatic control error burst

ABSTRACT: The stability of a 2-loop differential system without disturbance coupling is claimed to have been proven experimentally in the zero and negative error ranges. Differentiator inaccuracy equally affects both the combined and differential systems, insofar as their invariant-region-alignment stability is concerned. Experiments were staged on a speed-regulator model with not too abrupt disturbance changes and with $n > m$. Two conditions prevent a positive error burst at the start of a transient: a limited acceleration and a higher order of the left-hand member in $\frac{d\lambda}{dt^2} < \left(\frac{v}{\tau}\right)_{1\xi}$ and $0 < \varphi \leq n - m$. With these conditions

Card 1/2

ACCESSION NR: AP4026840

breached, the controlling variable necessary for absolute invariance falls outside the linear part of the characteristic which causes a short burst of positive error. Later on in the process, the occurrence of both positive and zero and even negative dynamic error is possible. This does not hold true for single-loop systems; they cannot be equivalent to negative-error systems and, therefore, the conversion of a multiloop into a single-loop system cannot be justified in this sense. Such a conversion results in a single-loop system with physically unrealizable components (infinite or negative amplification, etc.); this explains the incorrect view that the stable operation of a differential system without disturbance coupling is impossible under absolute-invariance and error-overcompensation conditions. Orig. art. has: 8 figures and 70 formulas.

ASSOCIATION: none

SUBMITTED: 10Nov63 DATE ACQ: 17Apr64 ENCL: 00

SUB CODE: DP, IE NO REF SOV: 007 OTHER: 001

Card 2/2

L 23320-66 EWT(d)/FSS-2/T/EWP(1) IJP(c) BB/GG

ACC NR: AP6009783 SOURCE CODE: UR/0102/66/000/001/0007/0021

AUTHOR: Vasyl'yev, V. I. -- Vasil'yev, V. I. (Kiev, L'viv); Lyakhnenko, O. H. -- Lyakhnenko, A. G. (Kiev, L'viv); Lamtsheva kyy, H. O. -- Lemtsheva, G. A. (Kiev, L'viv); Reuts'kyy, V. Yu. -- Reutskiy, V. Ye. (Kiev, L'viv)

ORG: none

48
B

TITLE: Algorithm of recognition systems of the perception type with a correlation on the input

SOURCE: Avtomatyka, no. 1, 1966, 7-21

TOPIC TAGS: algorithm, recognition system, perceptron, autocorrelation function, digital computer, analog television system

ABSTRACT: This paper deals with a recognition system, consisting of a correlator and perceptron, designed for recognition of patterns on a uniformly illuminated background. To reduce the size of the recognition system, a two-dimensional autocorrelation function is employed as the input description. This function is invariant to some isomorphous transformations. A new autocorrelation function, obtained by "positive" and "negative" images, is proposed, which permits the reduction of the dimensions of the apparatus. The algorithm for calculating the autocorrelation function is adapted for digital computers. An analog television variation of the autocorrelator is also described. The percep-

Card 1/2

L 23320-66

ACC NR: AP6009783

tion part of the system (choice of properties, marks—random prototypes, etc.) is calculated. The results of the simulation will be presented in the next paper. Orig. art. has: 6 tables, 7 formulas, and 8 figures. [Based on author's abstract] [AM]

SUB CODE: 09, 17/ SUBM DATE: 14Oct65/ ORIG REF: 003

Card 2/2 FW

ACC NR: AP7006772 SOURCE CODE: UR/0102/66/000/006/0031/0034

AUTHOR: Ivakhnenko, O. H. -- Ivakhnenko, A. G. (Kiev)

ORG: none

TITLE: Indeterminated prediction models

SOURCE: Avtomatyka, no. 6, 1966, 31-34

TOPIC TAGS: random process, mathematic prediction, binary logic, simulation, queueing theory

ABSTRACT: Models with accelerated processes that are frequently used for the simulation and prediction of real processes, as in several such models designed by J. Coales for servomotor optimization, are analyzed. A modified application of identical assemblies using random number generators is suggested. Such models are said to be indeterminated if they are equipped with binary generators with a probability distribution close to 0.5. The applicability of such a model for the determination of the random function of the loading curve of the output conveyor of a coal mine was tested with satisfactory results. Identical models can be used for the prediction of the flood volume of rivers, for the determination of the maximum and minimum loading capabilities of roads and thoroughfares and aircraft, for the prediction of movie attendance, and for a variety of other applications. Orig. art. has: 4 figures.

SUB CODE: 13,12,09/ SUBM DATE: 7Jul66/ ORIG REF: 001/ OTH REF: 004

Card 1/1